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comites near them, and the photograph shows the stars down to 14th or 15th mag.

Neither Herschel nor Rosse has published drawings of the cluster, and the value of the photograph will chiefly be in the future, when other photographs have been taken and correlated with it.

Photograph of the Nebula ♅ II 240 *Pegasi.*
By Isaac Roberts, D.Sc., F.R.S.

The photograph of the nebula ♅ II 240 *Pegasi*, an enlargement of which to the scale of 15 seconds of arc to one millimetre is now presented, was taken on 1891 December 2, with an exposure of the plate during 2 hours and 36 minutes. The nebula is No. 5,046 in the *General Catalogue*, R.A. 23^{h} 58^{m}, Decl. 15° 33′ north. It is figured in the *Phil. Trans.* 1861, pl. 30, fig. 42, p. 736, where the Earl of Rosse describes it as bright, pretty large, elongated, gradually much brighter in the middle; and in his *Observations of Nebulæ and Clusters of Stars* 1855 to 1860, p. 177, pl. 5, he gives another drawing of the nebula, and states that a decided dark lane runs through it, in the direction of its major axis. This feature is also shown on both the drawings which have been referred to.

Sir John Herschel, in his *Observations of Nebulæ and Clusters of Stars*, p. 481, describes the nebula as bright, large, irregularly round, 2′ or 3′ diameter, no nucleus, but he does not refer to the dark lane or to the surrounding nebulosity.

The photograph very fully confirms the observations, and the drawings made by the Earl of Rosse, excepting the widening out of the faint nebulosity at each extremity of the major axis, which the photograph does not show. The dark lane is conspicuously visible, and it divides the major axis into two equal parts. The central part of the nebula is a globular mass, and measures 41 seconds of arc in diameter, but it differs from a star in not having a central inner condensation or nucleus. The dark lane measures about eight seconds of arc in breadth, which is uniformly maintained as far as it can be traced on the photograph, except at the place where it crosses the denser part of the globular mass. There it is narrower, and less distinctly visible.

The inferences that I draw from the photograph are, that the dark lane is a ring, seen edgewise, surrounding the globular mass, and that there is another very wide, nebulous, faint ring surrounding the central mass, between it and the dark outer ring. The outer ring intercepts the light of the inner nebulous ring, and where it crosses the luminous central condensation the light is intercepted in a lesser degree, in the manner seen when the ring of *Saturn* is viewed nearly edgewise across the planet.

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Telescope Objectives for Photographic Purposes.

By H. Dennis Taylor.

The larger number of telescopes for mapping and surveying the heavens by means of photography have already been made, and it may be assumed that the best form of objective to satisfy the requirements has been ascertained in practice, at any rate approximately. Nevertheless, I think that the remarks which I have to offer will certainly be of interest to those numerous members of this Society who have more or less devoted their mathematical bent of mind to the kindred science of optics, with the theoretical and practical advancement of which the science of astronomy is very closely concerned.

It was wisely decided at the Paris Convention that the standard objective for celestial photography should be so corrected as to have its minimum, or most intense focus for the G ray, to which the ordinary rapid bromide plate is most sensitive. This, together with the focal length and aperture, was about all which the Convention prescribed. It did not seem to be widely enough recognised that the *form* of the objective would have a *great deal* to do with its efficiency as regards the size of field yielded by it. Dr. Steinheil, however, conscious of the importance of the *form*, made two recommendations, which were accepted by the Convention, and which ran to this effect:— The ratio between the sine of the angle of incidence on the first surface for a ray parallel to the axis, but striking the edge of the objective, and the sine of its angle of emergence at the fourth surface, must be equal to the ratio between the sines of angles of incidence at first surface and emergence at fourth surface for another ray, also parallel to the axis, but striking the objective at a point much nearer its centre. This is the condition under which the objective will give the best possible lateral image. Also, a white ray parallel to the axis, but striking the edge of the O. G, must not only have those coloured constituents which the O. G is supposed to refract to the same focus, emerge at the fourth surface in such a manner as to proceed to the same focus, but they must also emerge *at the same point* at the fourth surface; this is the condition that the images in both colours shall be of the same size.—For my part, I confess that I do not grasp the necessary relation between Dr. Steinheil's two conditions and the two advantages respectively aimed at, although I find that the first condition certainly does hold good in an objective corrected for the largest possible field. But, granting the relations to be correct, it cannot be said that Dr. Steinheil's conditions would facilitate a direct calculation of the curves, &c., necessary to fulfil the third and fourth of the several conditions following, the first three being indispensable and the last two very desirable:—

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